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Research Article

Science Teaching Materials Based on Marine Aquaculture Bioecology Using Floating Net Cage Technology to Improve Science Literacy Skills for Middle School Students in Coastal Lombok

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Abstract.
This research aimed to develop science teaching materials based on marine aquaculture bioecology using floating net cage technology that is practical and effective in improving students' scientific literacy skills at Lombok coastal schools. This was development research based on the Thiagarajan 4D model, which consists of four stages: design, define, develop, and disseminate. The research subjects consisted of six junior high schools on the coast of Lombok, who were selected using the purposive sampling technique. The instrument used was a scientific literacy assessment of 16 reasoned multiple choice questions. Data were analyzed using normalized gain analysis. The results showed that science teaching materials based on marine aquaculture bioecology with floating net cage technology were effective in increasing the scientific literacy skills of students in the six sampled schools, obtaining an average N-gain value of 0.5 in the medium category.

Keywords: marine aquaculture, bioecology, scientific literacy skills

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1. INTRODUCTION

The development of teaching materials is one of the processes that must be considered. Teaching material is a tool that can support the learning implementation [1]. The implementation of learning at every level of education is required to provide teaching materials that can facilitate student learning activities [2]. One of the problems that is still an obstacle in schools is the availability of teaching materials for students to study independently [3, 4]. Based on a preliminary study conducted in several schools located on the coast of East Lombok Regency, NTB, the teaching materials used by students

for learning activities are teaching materials that still rarely integrate real-world learning into the material.

The coastal area is used by the community as a place for economic activity in the form of ecotourism development services, a place to find fish, and as a location for developing fish farming businesses. Furthermore, the form of utilization of coastal areas in the form of cultivation has significant relevance for poverty alleviation [5]. Aquaculture has been shown to significantly increase the income of small fishermen [6].

The southern coastal waters of Lombok Island utilize the coastal area as a place to develop a diversity of marine aquaculture as a source of livelihood [7]. The advantages of developing aquaculture on the southern coast of Lombok Island are: (1) coastal waters are still available for cultivation, (2) fishermen have enough time to carry out cultivation, (3) Cultivation can be done in groups. Furthermore, environmentally friendly cultivation can have a positive impact on; (1) new job opportunities for members of fishermen's families and communities, and (2) overcoming temporary economic needs and (3) means of saving. In addition, the potential for seeds and feed sources from the surrounding environment is sufficient for the sustainability of environmentally friendly cultivation at the study site [8].

Currently, aquaculture commodities with high economic value being developed in the study area are baronang fish and lobster [7]. The cultivation system used is aquaculture technology in the form of floating net cages (KJA). KJA is a fairly productive aquaculture technology which consists of net cages mounted on floating rafts in coastal waters [9]. Cultivation with marine cage technology has many advantages [10]. One of the advantages of fish farming with KJA is that fish can be kept in high density, save land, have high productivity, do not require special water management, the quantity and quality of water is always adequate, predators are easy to control, and easy to harvest products.

Cuttlefish is one of the fish that has abundant potential for seeds in the study area. It is proven by the results of a study from Syukur et al [11] which shows the average catch of cuttlefish seeds per month is 1293.5 individuals with varying sizes. The presence of abundant cuttlefish seeds is a consideration in the development of cuttlefish aquaculture in the study area as an alternative to aquaculture commodities other than lobster cultivation. Commercial development of cuttlefish aquaculture at the study site is likely to have a high impact on fishery production in the near future. That's because the growth is relatively fast in two weeks the length increase can reach 1-2 cm, then the weight increases by 30-50 grams. Fish growth is generally influenced by genetic factors, behavior and eating habits of fish [12]. Furthermore, in addition to its fast

growth, reproduction of cuttlefish is also fast, in its development high tiller resistance along with appropriate feeding in an effort to cultivate it is quite easy and commercially it will probably have a high impact on fishery production in the near future [13, 14].

Local potential in the form of marine cultivation developed at the study site can be utilized in the world of education as teaching materials [15]. The use of teaching materials in learning is more effective because teaching materials are more than student activities [16]. Teaching materials that relate the learning process to environmental content will foster students' critical, creative, communicative, and collaborative thinking skills. Furthermore, teaching materials sourced from the surrounding environment can serve to help students' literacy skills [17]. In addition to the problem of the lack of availability of teaching materials, the State of Indonesia is also faced with the problem of the low scientific literacy of students [18, 19]. The literacy rate of Indonesian students from the results of the PISA assessment in 2018 shows that Indonesia is still in a relatively low rank, namely ranking 74 out of 79 countries with a score of 396 [20]. Therefore, the use of teaching materials sourced from the environment can be an important instrument in improving students' scientific literacy skillsThe goal of this project was to provide science teaching materials based on marine aquaculture bioecology using effective floating net cage technology to increase students' scientific literacy abilities in Lombok's coastal schools.

2. RESEARCH METHOD

This research is a development research based on the Thiagarajan 4D development model [21] which has 4 development stages, namely define, design, develop, and disseminate. This research is part of the implementation of the development phase using 6 schools located in East Lombok. Learning is carried out using a before-after research design to see the effect of using science teaching materials based on marine aquaculture bioecology with floating net cage technology on students' scientific literacy skills. The learning model used is a discovery learning model which includes 6 (six) stages, namely stimulation, problem statements, data collection, data processing, verification, and generalization.

The research subjects consisted of 6 junior high schools on the coast of East Lombok, NTB which were determined by purposive sampling technique. The number of samples in this study amounted to 175 students. The instruments used include scientific literacy assessment instruments. Before being utilized, the scientific literacy assessment instrument must pass a validity test, a reliability test, a distinguishing power test, and a

degree of difficulty test. The technique of collecting scientific literacy data is using multiple choice instruments that refer to scientific literacy indicators. The scientific literacy assessment given to students before learning (pretest) and after learning (posttest) was then analyzed using N-gain analysis.

3. RESULT AND DISCUSSION

At the design stage, the researcher designs the concept of design and graphic design of teaching materials will be developed. Teaching material concept method includes planning material ideas that will be made associated with the phenomena of everyday life and current technology, as well as plans to add Graphics to become material to train students in analyzing. Teaching material design including cover page design, material display design and additional supporting features to train scientific literacy. Its cover page is designed by integrating related images of cuttlefish cultivation. The following is an example of the display of the developed teaching materials as shown in Figure 1.

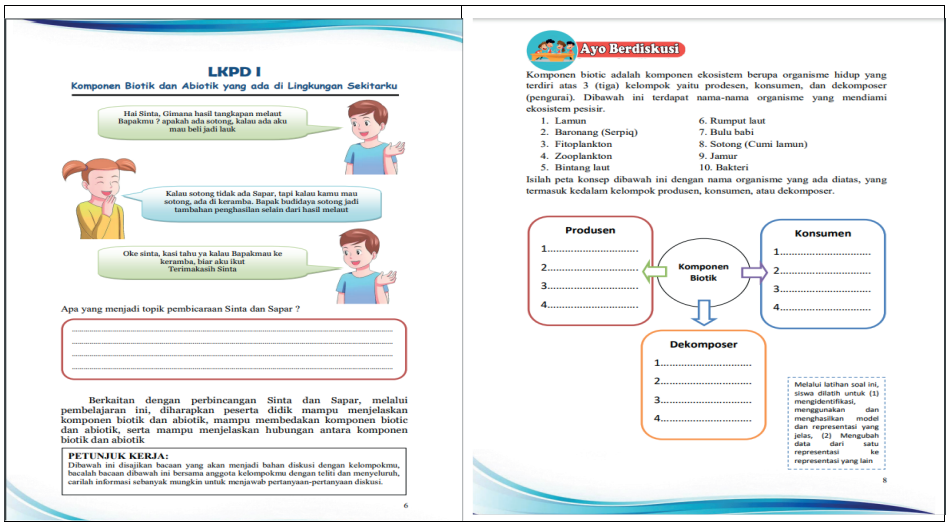

Figure 1: Developed teaching materials.

Scientific literacy is the capacity to use scientific knowledge, identify questions and draw conclusions based on facts to understand the universe and make decisions about changes that occur due to human activities [22]. Science competence possessed by students will improve many of their skills in everyday life, such as the ability to solve problems creatively, think critically, work cooperatively in groups, and use technology informatively and effectively. The measured scientific literacy ability consists of five indicators, namely (1) the ability to remember and apply appropriate scientific knowledge, (2) identify, use and produce clear representation models, (3) change data from

one representation to another, (4) analyze interpretation data and draw appropriate conclusions, and (5) identify assumptions, evidence, and reasons in texts related to science.

Research has been carried out in MTs. Bahrul Ulum NW Telaga Bagik, SMPN 2 Keruak, MTs. Yaqin 2 Pemondah, SMPN 1 Jerowaru, SMPN 2 Labuhan Haji, and SD-SMP SATAP 1 Labuhan Haji from April 19 to May 29 2021. Students' scientific literacy skills were obtained through Pretest (O_1) and Posttest (O_2) data and then analyzed using the normalized N-gain formula. The results of the scientific literacy assessment of students are presented in Table 1.

TABLE 1: Data on the results of the scientific literacy assessment of students on a large-scale trial.

No	School name	(O_1)	(O_2)	N-gain	Category N-gain
1.	MTs. Bahrul Ulum NW Telaga Bagik	31	69	0.6	Medium
2.	SMPN 2 Keruak	46	72	0.5	Medium
3.	MTs. Yaqin 2 Pemondah	35	67	0.5	Medium
4.	SMPN 1 Jerowaru	44	69	0.5	Medium
5.	SMPN 2 Labuhan Haji	48	72	0.5	Medium
6.	SD-SMP SATAP Labuhan Haji	45	66	0.4	Medium
Average		**42**	**69**	**0.5**	**Medium**

Information:

O_1 : Average of Pretest

O_2 : Posttest of Average

According to Table 1, the average pretest score of students was 42, with a considerable improvement in the posttest average of 69. The increase in students' scientific literacy skills was in the medium category with an average N-gain value of 0.5. For more details, see Figure 2 and Figure 3.

The data presented in Figure 2 and Figure 3 show that there is an increase in students' scientific literacy skills with an N-gain score of 0.5 in the medium category. The highest increase was obtained by students at MTs Bahrul Ulum NW Telaga Bagik with an N-gain score of 0.6. This increase shows that the use of science teaching materials that are integrated with the local potential of coastal villages, namely the development of marine aquaculture with floating net cage technology is effective in improving students' scientific literacy skills. The improvement of scientific attitude has also been carried out by Saputra, et al [23] with an N-gain of 83%. Students' scientific attitude is needed to build students' knowledge and understanding of a concept that

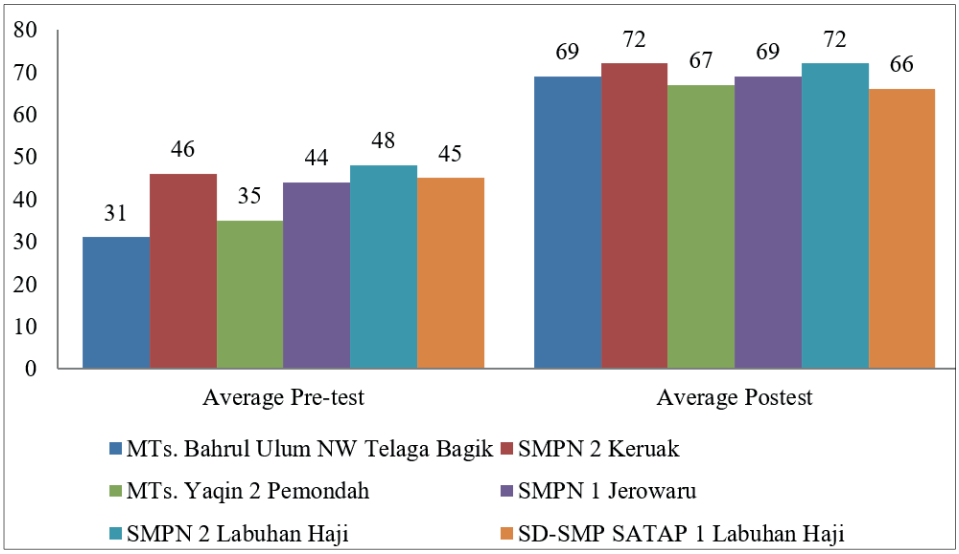

Figure 2: Comparison graph of the average pre-test and post-test.

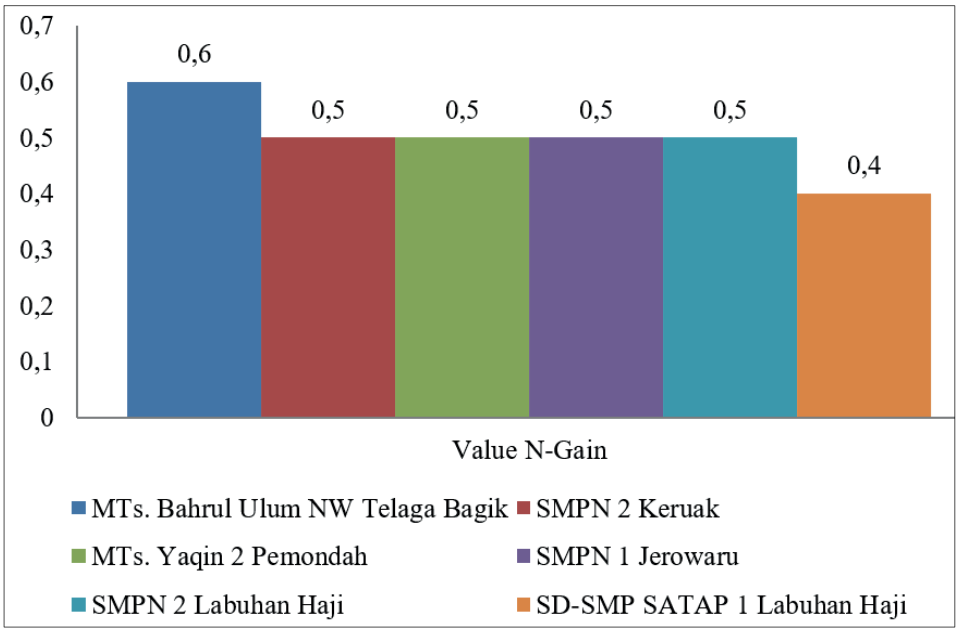

Figure 3: Comparison graph of N-gain values.

the teacher wants to convey. Students' scientific attitudes also show students' behavior in applying knowledge and science process skills needed in everyday life.

The teaching materials used for the resulting marine context have the following characteristics (1) presenting factual, conceptual, and marine-related learning materials; (2) combining physics, biology, and chemistry; (3) center on students; and (4) oriented to scientific literacy.

The results of this study are in line with the statement of Sukmawan and Setyowati [24] who said that the use of teaching materials sourced from the surrounding environment can serve to help students' literacy skills. In addition, the use of materials that are close to the environment around students can stimulate the curiosity of students and increase the enthusiasm of students in extracting information from the material studied in teaching materials. Teaching materials that connect the learning process with environmental content will also foster students' critical, creative, communicative, and collaborative thinking skills [25, 26].

Then from the 5 indicators of Science Literacy that were measured, the highest increase was obtained by students in indicator 4, namely analyzing interpreting data and drawing the right conclusions. In the pre-test, the average score was 36, then there was a significant increase in the post-test average score of 72. Based on the discussion above, it can be concluded that marine culture-based science teaching materials with floating net technology are effective in improving literacy skills. Science for junior high school students on the coast of Lombok.

4. CONCLUSION

Science teaching materials based on marine aquaculture bioecology with floating net cage technology are effective in improving students' scientific literacy. This is evidenced by the results of the scientific literacy test of experimental class students showing an increase in the moderate category while in the control class there was an increase with moderate criteria.

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